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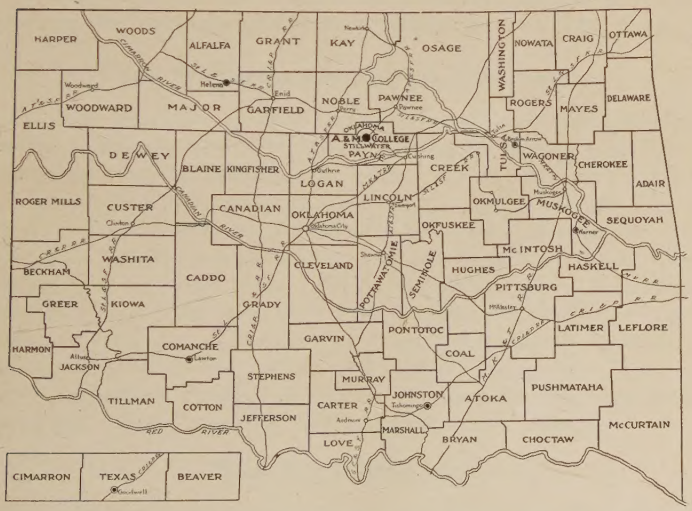
DEEP PLOWING AND SUBSOILING

BY A. H. WRIGHT
DEPARTMENT OF AGRONOMY



Map Showing Location of A. and M. College and District Agricultural Schools

STILLWATER, OKLAHOMA

DEEP PLOWING AND SUBSOILING

The experiments conducted at the Oklahoma Experiment Station on both depth of plowing and subsoiling are not sufficiently extensive nor complete to decide the many questions relating to these subjects, yet some very valuable work has been done, which seems to be deserving of publication.

The following experiments along these lines have been conducted:

General subsoiling tests.

Depth of plowing for wheat.

Depth of plowing for corn, oats and cotton.

The results obtained from subsoiling and depth of plowing for wheat have been published in previous bulletins of the Station and consequently need be but briefly discussed at this time. A fairly complete discussion of the depth of plowing experiment will be given.

In order to study these tests to the best advantage it is necessary to describe the local conditions under which the tests were conducted.

Local Conditions Affecting the Experiments

All these experiments have been conducted upon medium upland, described physically as a silt loam. The subsoil is very hard and impervious, and can be described as a fine, sticky clay; dark brown to black in color. The surface and subsurface layers are not very distinct, or in other words, they gradually blend into each other. There is very little organic matter present and also very little sand. Chemical analysis shows that these soils have sufficient plant food present to produce ample crops, although they are somewhat deficient in phosphorus. Analysis shows further that there is no material difference in composition between the surface and subsurface layers. These soils go into suspension readily; on drying out they become very hard to considerable depths and the surface easily crusts over.

Subsoiling Experiments

Subsoiling experiments were begun more than ten years ago. The results obtained indicated that subsoiling is an unprofitable practice on the soils of the Station farm. Not only the work of this Station, but all tests in the Southwest, so far as we are familiar with them, agree in indicating that subsoiling is not a profitable farm practice. Among the other experiments with subsoiling which have been conducted in

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the Southwest, by far the most valuable are the ones conducted at San Antonio, Texas, by the Bureau of Plant Industry of the U. S. Department of Agriculture, and reported in B. P. I. Circular No. 114. This publication summarizes three years' work as follows:

1. Subsoiling is an expensive practice, and so adds to the cost of preparation for a crop that unless materially increased yields result it cannot be profitably adopted as a regular farm practice.

2. Subsoiling has been tested at the San Antonio Experiment farm for three years in rotation experiments with corn, cotton and oats for hay and for grain.

3. The yields of corn, cotton and oats for hay and for grain have been either slightly increased or slightly decreased on subsoiled land. In no instance has the difference been significant.

4. In the soil moisture studies so far made at San Antonio it has been found that subsoiling has not increased the moisture content of the soil.

5. The results of these tests indicate that since neither the moisture content of the soil, nor the yields of corn, cotton and oats are increased by subsoiling, the practice is not advisable in connection with the crops mentioned in the San Antonio region of Texas.

Experiments in Depth of Plowing for Wheat

An experiment on depth of plowing for wheat was outlined in 1906 and continued for four successive years. The plots were prepared in duplicates as follows:

Disked only.
Plowed to a depth of three inches.
Plowed to a depth of four inches.
Plowed to a depth of five inches.
Plowed to a depth of six inches.
Plowed to a depth of seven inches.
Plowed to a depth of eight inches.
Plowed to a depth of nine inches.

All plots were plowed each season about the first of August. Aside from the depth to which the plots were plowed, all plots received the same cultural treatment. Averaging the results obtained for the four years, it was found that the lowest yield, which was ten bushels per acre, was produced from the disked plots, and the highest yield, which was sixteen bushels per acre, was procured from the plots plowed to a depth of seven inches. There was practically no difference between the 7, 8 and 9-inch plowing.

The results of these tests with wheat indicate that on such soils as those of the Station farm average deep plowing is advisable, pro-

vided it is done early. The fact that no higher yields were obtained on the eight and nine-inch plots than on the seven-inch plots indicate that there is a limit to the depth to which soils of this type can be plowed with profit.

Experiments on Depth of Plowing for Corn, Oats and Cotton

In 1910 an experiment was outlined to test the effects of different depths of plowing upon yields of corn, oats and cotton. This experiment has been run continuously since 1910 and is still in progress. Since no results thus far obtained have been published, a complete description of the plan and cultural methods used will be given.

Plan of Experiment.—As originally outlined this experiment involved the growing of corn, oats and cotton in rotation. There are three blocks of six plots each. The plots are 272.25 feet long by 32 feet wide, or two-tenths acres in area. Plots 1, 2 and 3 are plowed five, ten and fifteen inches deep, respectively. Plots 4, 5 and 6 are duplicates of 1, 2 and 3, respectively. The plowing is done with a common moldboard plow on the five-inch plots and with the Spaulding Deep Tillage Machine on the ten and fifteen-inch plots. Considerable difficulty has been experienced in plowing to a depth of fifteen inches.

General Cultural Notes for 1910.—In the season of 1910 the plots were plowed in the late winter and seeded to corn, oats and cotton, at the proper time for each crop. This season was very unfavorable at the Station for the production of corn and cotton. The cotton was seeded at the proper time, but owing to a series of cold rains and prolonged cold weather a very poor stand was obtained. The cotton plots were replanted very late, and as a result but very little of the crop matured. The crop was considered a failure and no record of yields was taken.

The corn in 1910 was about completely destroyed by the hot winds and drouth. No grain was produced and weights of fodder only were recorded.

The season was favorable for oats and a good crop was produced.

General Cultural Notes for 1911.—In 1911 no records were obtained, as the crops were practically a failure in each case. The cotton was almost completely eaten up by the webworms, and the drouth and chinchbugs destroyed the oats and corn.

General Cultural Notes for 1912.—Some records were obtained in 1912, though the oats did not grow high enough to cut with a binder. They were very light and spotted. Records of yields were not taken.

Both cotton and corn were very poor. The corn was materially injured by the drouth and chinchbugs, and the cotton by the drouth and webworms.

In 1913 the general plan of crops grown in the rotation was some-

what changed. As corn in the experiment had failed practically every year it seemed useless to continue to attempt to grow it under the existing conditions. Kafir was substituted in place of corn. The present cropping plan is, therefore, kafir, oats and cotton.

The following table summarizes the results thus far obtained from the depth of plowing experiment:

Depth of Plowing

Table showing yields of corn, oats and cotton. (Kafir since 1912.)
Summary 1910-1912-1913

Crop.	Depth.	1910		1912		1913	
		Tons Forage Per Acre	Bushels Grain per Acre	Tons Forage Per Acre	Bushels Grain per Acre	Tons Forage Per Acre (Kafir)	Bushels Grain Per Acre (Kafir)
Corn .	5 in.	.486	.....	2.79	5.5	3.29	24.1
Corn .	10 in.	.516	.....	2.67	5.5	4.02	27.9
Corn .	15 in.	.557	.....	3.30	5.1	4.26	27.8
Oats ...	5 in.	.....	44.8	.....	.....	.....	26.5
Oats ..	10 in.	.....	39.3	.....	.....	.....	25.2
Oats ...	15 in.	.....	33.4	.....	.....	.....	27.8
				Seed and Lint per Acre			Seed and Lint per Acre
Cotton	5 in.	.....	.....	770		.....	480
Cotton	10 in.	.....	.....	695		.....	495
Cotton	15 in.	.....	.....	592		.....	495

In studying the data in the foregoing table it is necessary to keep in mind the condition of both soils and climate under which the experiments were conducted. This has been previously discussed.

The comparative production on the different depths of plowing does not vary materially except in the case of oats for 1910. With this crop the yield decreased uniformly as the depth increased. This bears out the usual statements relative to deep plowing; that is, the depth of the seedbed should be increased gradually in order not to bring to the surface too much inert subsoil. In this particular case, however, it is doubtful if the lower yields were due entirely to the "bringing up" of so much subsoil as it was to the fact that these plots were plowed rather late in the winter for the 1910 crop, and consequently the deeper plowing was not as well settled or compacted as the shallower plowed plots. In case of all other yields obtained from these plots since the experiment was begun, there is not enough difference in yield to justify attributing the cause to that of the depth to which the plots were plowed.

The results thus far procured with the depth of plowing tests indicate that on soil types similar to that of the Station farm, plowing

deeper than seven inches without the addition of any organic matter is not a profitable farm practice.

General Conclusions and Comments

The subject of deep plowing has been extensively advocated during the last few years by the agricultural press. Generally speaking, this subject is deserving of the consideration given it, but like most other farm questions can be over-valued or misrepresented.

What Is Deep Plowing.—The term "deep plowing" is used very loosely and may mean plowing to almost any depth, up to a foot or more. Ordinarily farmers in the Southwest plow from three and one-half to six inches deep. We can consider deep plowing then as the stirring of the soil to a depth of more than seven inches. For such field crops as corn, cotton, wheat and kafir, plowing from five to seven inches can be considered "good plowing".

Factors Determining What Depth to Plow.—Just how deep to plow is determined by the net profits obtained from plowing to different depths. Whether or not it will pay to plow deeper than seven inches depends upon several factors, chief among which are:

Cost of the operation.
Type of soil involved.
Class of crops grown.

Deep plowing is expensive, but not as expensive as subsoiling. To plow deeper than seven inches requires, in most soils, special machinery and greater horsepower than for ordinary plowing. The greater yields obtained must offset this additional cost before the operation can be considered a profitable one.

The type of soil will greatly affect the profitableness of deep plowing. On soils such as those of the Station farm, which have been previously described, we are inclined to the opinion, based on the data thus far procured, that deep plowing is not profitable. Soils similar in type to those of the Station farm are prevalent in western Oklahoma and occur to some extent in nearly all parts of the State. Such soils when plowed deep require a great deal of additional horsepower, and as soon as a few rains fall upon them the particles "run together" or re-cement and are as hard and unworkable as before.

In taking soil samples of the five, ten and fifteen-inch plots six months after they were plowed it was found that the deeper plowed plots were no more easily penetrated by the soil sampler to a depth of fifteen inches than was the shallower plowed plots. In plowing these plots every season, plots which had been previously plowed ten and fifteen inches were no more easily plowed than when first stirred to that depth.

If one were to add organic matter such as barnyard manure and then plow to a depth of ten or fifteen inches, different results might

be obtained. But where the operation is merely one of deep plowing there seems to be no advantage in favor of plowing to depths of more than seven inches on the type of soil under consideration.

With loose, sandy soils the expense of deep plowing would be appreciably less. The fact, however, that such soils are ordinarily too loose or open in structure would lead one to conclude that it would be useless to plow deeper than six or seven inches, and on some sandy soils still shallower plowing is advisable. This is especially true with sandy soils which "blow" easily.

Heavy loams, limestone or shale soils underlaid with a reasonably open subsoil could surely be plowed deep to advantage. The general experience of farmers seems to bear out this statement, though there is practically no reliable information on just how deep such soils can be plowed with profit. In preparing a seedbed for the staple grain and cultivated crops it is very doubtful if it will ever pay to plow to such depths as ten to fifteen inches.

From a crop production standpoint the purpose of deep plowing would be to bring up subsoil, which is richer in mineral matter, near enough the surface to be usable by the plants, and to increase the water content of the soil, and also to loosen up the deeper soil layers so that they may be more easily penetrated by deeper rooted plants, such as alfalfa. Plowing to very great depths, therefore, would not seem to be advisable, as has been previously stated, for the staple grain and cultivated crops. In the case of alfalfa everything indicates that plowing can be done to considerably greater depths with profit. This is especially true since alfalfa is a permanent crop and it is necessary to prepare the seedbed but once in several years.

A Final Word.—Attention is called to the fact that while there is very conclusive evidence to the effect that subsoiling is seldom, if ever, a profitable farm practice, yet there is very little reliable information on the subject of deep plowing as a profitable or unprofitable practice on the various types of soils which are represented in Oklahoma. As a result of this it is necessary to avoid positive statements.

It might be well to say farther that reasonably deep plowing, meaning plowing from five and one-half to seven inches, is to be strongly recommended on practically all soils and for all crops, and that on some particular types of soils, or for certain crops, deeper plowing seems to be worthy of attention. Only in very unusual cases, however, does it seem advisable to plow to very great depths.

A. H. WRIGHT,
Assistant Agronomist.

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